Claims

1. An optical head apparatus comprising:

a first optical system including a first objective lens for focusing a light beam upon an optical disc;

a second optical system including a second objective lens for focusing a light beam upon an optical disc having an information recording density smaller than the optical disc which the first optical system irradiates upon, the second objective lens having a numerical aperture smaller than the first objective lens; and

a deflecting element including a first reflecting surface for deflecting a light beam to an optical axis of the first objective lens in the first optical system, and a second reflecting surface for deflecting a light beam to an optical axis of the second objective lens in the second optical system.

2. An optical head apparatus according to claim 1, wherein the first optical system includes a first light source and the second optical system includes a second light source emitting a light beam having a wavelength longer than the first light source.

3. An optical head apparatus according to claim 2, wherein the second optical system further includes a third light source emitting a light beam having a wavelength longer than the second light source.

4. An optical head apparatus according to claim 3, wherein the first reflecting surface and the second reflecting surface are arranged so as to deflect a light beam

traveling from the first light source to the first reflecting surface and a light beam traveling from the second light source or the third light source to the second reflecting surface, to which are opposite and substantially parallel, in such a way to propagate from the respective reflecting surfaces substantially in parallel to each other.

5. An optical head apparatus according to claim 4, wherein the deflecting element includes a triangle prism.

6. An optical head apparatus according to any one of claims 1 to 5, wherein the first objective lens and the second objective lens are arranged along a tangential direction to a track on an optical disc.

7. An optical head apparatus according to claim 6, wherein the second objective lens is disposed on a line substantially passing a center of the optical disc, and the first objective lens is disposed at a position out of the line.

8. An optical head apparatus according to any one of claims 2 to 7, wherein the light beam from the second light source is irradiated upon a DVD.

9. An optical head apparatus according to any one of claims 1 to 8, wherein the second objective lens is thinner than the first objective lens.

10. An optical head apparatus according to any one of claims 1 to 9, wherein the first objective lens has an outer diameter smaller than the second objective lens.

11. An optical head apparatus according to any one of claims 2 to 10, further comprising:

a first diverging element for deflecting a light beam traveling from the first light source to the deflecting element to a direction substantially parallel to the optical disc; and

a second diverging element for deflecting a light beam traveling from the second light source to the deflecting element to a direction substantially parallel to the optical disc.

12. An optical head apparatus according to claim 11, further comprising:

a light detector disposed opposite to the first light source with respect to the first diverging element in the first optical system,

wherein the first diverging element includes a first reflecting surface for reflecting the light beam from the first light source to the deflecting element and a second reflecting surface for reflecting the light beam form the deflecting element to the light detector.

13. An optical head apparatus according to claim 6, further comprising:

an objective lens actuator including;

a base;

a movable body for holding the first objective lens and the second objective lens;

a slender elastic support member for movably supporting the movable body movable in a focusing direction and a tracking direction with respect to the base;

a first focusing driver for driving the first objective lens in the focusing direction;

a second focusing driver for driving the second objective lens in the focusing direction;

a first tracking driver for driving the first objective lens in the tracking direction; and

a second tracking driver for driving the second objective lens in the tracking direction;

wherein the slender elastic supporting member extends in a tangential direction to the optical disc.

14. An optical head apparatus according to claim 13, wherein

the first focusing driver includes a first focusing coil mounted on a first objective lens side of the movable body, and a first magnet fixedly attached to the base in a position opposite to the first focusing coil,

the second focusing driver includes a second focusing coil mounted on a second objective lens side of the movable body and a second magnet fixedly attached to the base in a position opposite to the second focusing coil.

15. An optical head apparatus according to claim 14, wherein the objective lens actuator is set so as to make the phase of a driving signal for moving the second objective lens in the focusing direction later than that for the first objective lens, and includes phase advancing means for advancing the phase of the driving signal for moving the second objective lens in the focusing direction against that for the first objective lens in a predetermined frequency region when focus control is executed to

the second objective lens.

16. An optical head apparatus according to claim 15, wherein the phase advancing means includes a phase filter which advances a phase of a driving signal supplied to the focusing coil in the second focusing driver in a predetermined frequency region.

17. An optical head apparatus according to claim 14, wherein the objective lens actuator is so as to make the phase of a driving signal for moving the first objective lens in the focusing direction later than that for the second objective lens, and includes phase advancing means for advancing the phase of the driving signal for moving the first objective lens in the focusing direction against that for the second objective lens in a predetermined frequency region when focus control is executed to the first objective lens.

18. An optical head apparatus according to claim 17, wherein the phase advancing means includes a phase filter which advances a phase of the driving signal supplied to a focusing coil in the first focusing driver within a predetermined frequency region.

19. An optical head apparatus according to claims 16 or 18, wherein the phase filter includes a combination of a high-pass filter and a low-pass filter for advancing the phase of the driving signal within a predetermined frequency region.

20. An optical head apparatus according to any one of claims 15 to 19, wherein the predetermined frequency region is a frequency region where an inherent resonance of the slender elastic support member occurs.

21. An optical head apparatus according to any one of claims 14 to 20, wherein

the first focusing coil and the second focusing coil are disposed in both sides of a plane passing a gravity center of the movable body and perpendicular to the tracking direction,

the movable body is tiltable about an axis extending along the tangential direction by adjusting an electric current supplied to the first focusing coil and the second focusing coil.

22. An optical head apparatus according to claims 15 or 16, wherein the movable body is so disposed that the gravity center of the movable body is closer to the first focusing coil than the second focusing coil along the tangential direction to delay the moving phase of the second objective lens in the focusing direction.

23. An optical head apparatus according to claims 17 or 18, wherein the movable body is so disposed that the gravity center of the movable body is closer to the second focusing coil than the first focusing coil along the tangential direction to delay the moving phase of the first objective lens in the focusing direction.

24. An optical head apparatus according to claims 17 or 18, wherein a gap between the first focusing coil and the first magnet is set so as to be greater than a gap between the second focusing coil and the second magnet to delay the moving phase of the first objective lens in the focusing direction.

25. An optical head apparatus according to claims 15 or 16, wherein a gap between

the second focusing coil and the second magnet is set so as to be greater than a gap between the first focusing coil and the first magnet to delay the phase of the driving signal for moving the second objective lens in the focusing direction.

26. An optical head apparatus according to claims 17 or 18, wherein a magnetic field of the first magnet is generated so as to be smaller than that of the second magnet to delay the phase of the driving signal for moving the first objective lens in the focusing direction.

27. An optical head apparatus according to claims 15 or 16, wherein a magnetic field of the second magnet is generated so as to be smaller than that of the first magnet to delay the phase of the driving signal for moving the second objective lens in the focusing direction.

28. An optical information apparatus comprising:

an optical head apparatus according to any one of claims 1 to 27;

a motor for rotating the optical disc; and

a control circuit for receiving a signal from the optical head apparatus to control drive of the optical head apparatus and the motor based on the signal.

29. A computer comprising:

an optical information apparatus according to claim 28;

an input device or input terminal for inputting information;

a calculating device for calculating based on information inputted by the input device or information reproduced by the optical information apparatus; and

an output device or an output terminal for displaying or outputting information inputted by the input device, information reproduced by the optical information apparatus, or a result calculated by the calculating device.

30. An optical disc player comprising:

an optical information apparatus according to claim 28; and

an information-to-image decoder for converting an information signal generated by the optical information apparatus to an image.

31. A car navigation system comprising:

an optical information apparatus according to claim 28; and

an information-to-image decoder for converting the information signal generated by the optical information apparatus to an image.

32. An optical disc recorder comprising:

an optical information device according to claim 28; and

an image-to-information encoder for converting image information to information to be recorded by the optical information apparatus.

33. An optical disc server comprising:

an optical information apparatus according to claim 28; and

an input-output terminal for allowing information communication with outside.